in Excuse of this Trouble, farther than that I have the Honour to be with great Respect,

S I R,

London, Jan. 14.
1746-7.

Your most obliged,

and humble Servant,

Richard Brocklesby.

XIII. *A Letter from Mr.* Richard Dunthorne, *to the Rev. Mr.* Cha. Mason, *F. R. S. and* Woodwardian *Professor of* Nat. Hist. *at* Cambridge, *concerning the* Moon's *Motion.*

S I R, Cambridge, Nov. 4. 1746.

Read Feb. 5.
1746 7.

IN the Preface to my lunar Tables, I hinted, that one Use of publishing those Tables would be, the assisting of Persons desirous farther to rectify the lunar Astronomy, by enabling them more readily to compare the *Newtonian* Theory with Observations.

Since the Publishing those Tables, I have spent some Time myself in that Comparison; and here send you the Result, that you may communicate it to the *Royal Society*, if you think it deserves to be made public.

As the Motion of every secondary Planet must partake of the Errors in the Theory of its primary, I thought proper, before I undertook the Examination of the lunar Numbers, to compare those of the Sun with Observations. I compared several Sets of
Mr.

Mr. *Flamstead's* Obfervations, after the Method he himfelf teaches, in *Prolegom. Hift. Cælest*, p. 133, *& feq*. which, for many Reafons, I think the beft Method hitherto ufed; and, with the Concurrence of a Gentleman well skilled in thefe Matters, deter‐ mined the mean Motion of the Sun at *Greenwich,* the laft Day of *December* at Noon, *Anno* 1700, O. S. ♈ 20° 43′ 40″ of its Apogee, ♋ 7° 30′ 0″, and the greateft Equation of the Sun's Centre 1° 55′ 40″; which, I am fully perfuaded, are very near the Truth.

The Theory of the Sun being thus fettled, I pro‐ ceeded to examine the Elements of the lunar Aftro‐ nomy. I began with Obfervations of lunar Eclipfes about the Equinoxes, when the Apogee of the Moon was in the Sun's Quadratures; becaufe at thofe Times I could conceive the Moon's Motion affected with no Inequality, but the annual one, called by *Newton* the firft Equation, and the elliptic one, called *Profthaphærefis*: From a Comparifon of fuch Obfervations I obtained the Moon's mean Longitude, which came out 1′, at leaft, greater than in the Ta‐ bles, and very nearly as *Newton* has it in the laft Edition of his *Principia*.

I went on to examine the Place and Motion of the Apogee, and Theory of the Increafe and De‐ creafe of the Eccentricity, as well as the greateft and leaft Eccentricities themfelves (from the beft Obfer‐ vations, and beft fituate that I could procure) all which agreed fo well with the Tables, about the Sun's mean Diftances, that I dare venture to make no Al‐ teration therein: Indeed I think the 6th Equation does not fo well account for the Variation of the Motion of the Apogee, and Change of the Eccen‐ tricity,

tricity, according to the greater or leſſer Diſtance of the Sun from the Earth; and therefore I ſet myſelf to compute what Change this Difference of the Sun's Action upon the lunar Orbit would introduce in the Moon's Place in every Situation of the Sun and Lunar Orbit; and found, after many tedious Computations, that the Sun being in Apogee, this Change, where greateſt, would amount to about 4′, and to 4′ 16″, when the Sun is in Perigee. In other Diſtances of the Sun from the Earth, this greateſt Change is proportional to the Difference of the Cubes of the mean and preſent Diſtances; and in every Situation of the Moon, and of her Orbit, the preſent is to the greateſt Equation nearly as the Sine of the Excefs of the Moon's mean Anomaly above twice the annual Argument to *Radius*. It increaſes the Moon's Longitude, when the Sun is in his $\left\{ \begin{array}{c} Apogeon \\ Perigeon \end{array} \right\}$ Semicircle, and that Excefs $\left\{ \begin{array}{c} \text{leſs} \\ \text{greater} \end{array} \right\}$ than 180°; and diminiſhes it when otherwiſe *.

In fine, I compared the Theory of the Moon, as to her Longitude, with ſeveral Obſervations, as well in the Octants and Semi-Octants, as in the Syzygies and Quadratures, and found ſuch an Agreement when the above Corrections were made, as ſeemed rather to be wiſhed than hoped for, conſidering the many Inequalities wherewith the Sun's Action diſturbs the Motion

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* If this Equation be increaſed and diminiſhed in a direct *Ratio* of the Moon's horizontal Parallax, it will become more exact. And I think, if it were always diminiſhed by a fourth or perhaps a third Part, it would agree better with Obſervations.

Motion of the Moon, and the Defects to which the best Obfervations I have hitherto met withal are liable.

I have compared 100 obferved Longitudes of the Moon with the Tables; *viz.* 25 Eclipfes of the Moon, all, except the firft, taken from *Flamftead's Hiftoria Cœleftis*, the *Philofophical Tranfactions*, and the *Memoirs* of the *Royal Academy of Sciences*; the two great Eclipfes of the Sun in 1706 and 1715; 25 felect Places of the Moon from *Flamftead's Hiftoria Cœleftis*, and 48 of thofe Longitudes of the Moon computed from *Flamftead's* Obfervations by Dr. *Halley* (as I fuppofe) printed in the firft Edition of the *Hiftoria Cœleftis*. They are as follows;

25 Eclipſes of the Moon, and 2 of the Sun, compared with the Tables corrected as above.

Place of Obſervation	A.D.	Apparent Time at Greenwich (h ' ")	D's true Place obſerved (s ° ' ")	M. An. ☉ (s °)	M. An. ☽ (s °)	Ann. Aret (s °)	D's Place compr'd (s ° ' ")	Diff. on Obſervat. (± ° ' ")
Danzick	1652	Septem. 7. — 6 21 35	11 25 25 51	2 20	6 2	0 3	1 25 26 10	+ 0 0 19
	1670	Sept. 18. — 14 36 48	0 6 13 29	3 1	6 0	0 0½	0 6 16 2	+ 0 3 8
Greenwich	1678	Octob. 19. — 8 21 54	1 6 47 9	4 1	7 16½	2 2	1 6 46 3	+ 0 0 31
	1632	Febr. 11. — 10 58 52	5 3 47 3	7 25	7 28½	1 14	5 3 46 13	+ 0 0 49
Paris	1684	Dec. 11. — 10 47 6	3 1 11 20	5 24	1 8	7 16	3 1 13 —	+ 1 0 47
Danzick	1655	Nov. 30. — 10 35 30	2 19 40 0	5 13	11 26½	5 25	2 19 39 46	+ 0 0 14
Dublin	1686	Nov. 19. — 11 13 11	2 8 11 57	5 2	10 12½	4 4½	2 8 11 29	+ 0 0 29
Greenwich	1639	Sept. 18. — 14 39 37	0 6 32 8	3 1	4 24	10 8	0 6 34 16	+ 0 2 8
	1690	March 14. — 9 55 50	6 4 37 11	8 25	9 18	3 15½	6 4 37 28	+ 0 0 17
	1696	May 6. — 12 2 0	7 26 53 14	10 18	3 1½	3 28	7 26 53 40	+ 0 0 26
Paris	1699	March 5. — 7 13 44	5 25 32 27	8 16	8 27	3 1	5 25 32 14	+ 0 0 13
New England	1703	Decem. 11. — 13 29 8	3 0 49 56	5 23	11 24½	5 23	3 0 48 51	+ 0 1 5
Marſeilles	1706	May 0. — 21 13 57	0 1 20 44	10 22	6 22	7 6	1 20 46 32	+ 0 2 12
Greenwich		Octob. 10. — 7 10 0	0 23 20	3 22	5 27	11 25	0 27 58 47	+ 0 0 33
	1707	April 5. — 13 39 0	6 26 18 33	9 17	11 9	5 3	6 26 19 0	+ 0 0 36
Paris	1708	Sept. 18. — 9 10 25	0 6 39 23	2 1	2 12	8 7	0 6 39 11	− 0 0 4
	1712	Jun. 12. — 7 34 0	4 2 57 47	6 24	7 17½	7 25½	4 2 58 37	− 0 0 50
London	1713	Nov. 20. — 15 27 30	1 9 53 21	5 3	6 21	3 17	1 9 56 50	− 0 1 25
	1715	April 21. — 21 11 5	1 12 0 22	8 26	6 12½	6 22	1 11 59 26	− 0 0 46
	1717	March 15. — 15 7 4	6 6 23 50	8 9	8 22½	2 27	6 6 22 31	+ 0 0 19
Paris	1719	Auguſt 18. — 8 22 40	11 5 42 8	1 29	10 23	4 20	11 5 42 35	+ 0 0 31
London	1722	June 17. — 13 46 10	9 6 47 43	11 29	5 8½	10 25	9 6 47 33	+ 0 0 10
	1724	Octob. 20. — 15 40 40	1 9 0 0	4 16	5 25½	5 22	1 8 58 50	− 1 1 10
Paris	1729	Febr. 2. — 8 42 55	4 25 13 39	7 16	3 25	9 14	4 25 14 40	+ 1 0 10
		July 28. — 13 0 0	10 16 15 28	1 9	8 3	2 15	10 16 16 26	+ 1 0 58
	1731	June 8. — 13 47 51	8 28 9 58	11 19	4 27	10 11	8 28 0 45	− 1 1 13
	1732	Nov. 20. — 0 49 25	2 10 3 54	5 3	7 8	1 24	2 10 0 50	− 2 2 58

25 Places of the Moon, computed by myself from *Flamstead's* Observations, compared with the Tables.

A.D.	Apparent Time at Greenwich			D's true Place observed				M. Anom. ⊙		M. Anom. D		Ann. Argt.		D's Place computed				Diff. from Observat.		
		h	'	"	s	°	'	"	s	°	s	°	s	°	s	°	'	"		'	"
1684	March 13.	8	9	8	2	28	48	40	8	25	2	25	11	19	2	28	50	44	+	2	4
1693	March 6.	7	22	48	3	16	43	12	8	17	3	11½	11	7	3	16	44	0	+	0	48
1694	Octob. 11.	18	12	34	3	28	34	2	3	24	2	27	5	15	3	28	38	21	+	4	19
	Febr. 27.	10	29	16	4	27	31	11	8	10	3	12	9	20	4	27	26	48	+	0	43
	August 23	11	13	54	11	0	19	11	2	5	8	2	2	21	11	0	21	41	—	2	30
1694	Septem. 15.	5	34	13	8	27	1	34	6	27	10	10	3	11	8	27	1	41	+	0	7
	Septem. 21.	10	50	31	11	22	47	41	3	3	3	3½	3	17	11	22	49	16	+	1	35
1695	Decem. 13.	6	2	53	0	6	28	43	5	25	8	26½	6	0	0	6	29	58	+	1	15
	Febr. 8.	3	55	22	1	5	14	3	7	21	9	7½	7	22	1	5	12	14	+	1	49
	July 9.	5	56	14	7	2	2	42	9	20	3	14	0	'	2	7	2	3	4		0	49
	Septem. 8.	8	30	26	10	3	0	12	2	20	5	21	1	24	10	2	59	50	—	0	22
1696	January 16.	17	29	2	7	5	4	20	6	29	2	29	5	20¼	7	5	6	11	+	1	51
	March 4.	8	9	13	4	12	2	24	8	16	11	8	7	3	4	12	0	59	—	1	25
1697	February 18.	6	29	47	2	20	52	29	8	1	8	19	5	10	2	20	51	7	—	1	22
	19.	7	22	57	3	4	18	16	8	3	9	2½	11	11	3	4	17	54	—	0	22
	Septem. 15.	7	54	41	10	1	1	7	2	23	3	21½	9	10	10	1	5	38	+	1	30
1698	Septem. 8.	11	2	35	11	12	15	6	2	21	3	24	2	23	11	12	15	27	+	0	21
1699	Novem. 27.	3	49	54	10	11	33	39	5	9	2	2½	3	10	10	11	31	15	—	2	26
1701	March 5.	12	8	23	5	28	15	59	8	16	8	29½	6	8	5	28	16	11	+	1	12
1702	Septem. 28.	6	55	23	9	27	13	17	3	10	9	9	9	8	9	27	12	49	+	0	28
	Octob. 16.	6	15	49	10	3	25	41	3	28	11	11½	13	10	10	3	26	27	+	0	46
1703	Septem. 13.	11	58	50	11	28	50	30	8	25	3	28	3	3	11	28	53	30	+	3	0
1706	Octob. 6.	6	28	39	9	27	1	44	3	18	7	4	3	23	9	27	0	38	—	1	6
	Octob. 10.	11	11	10	1	1	11	15	3	22	6	0	11	25	1	1	10	17	—	0	58
1714	Septem. 6.	6	34	7	9	3	44	13	2	18		17	9	0	9	3	45	24	+	1	11

48 Places of the Moon, computed by Dr. *Halley*, from *Flamstead*'s Observations, compared with the Tables.

A.D.	Apparent Time at Greenwich			☽'s true Place observed				M. Anom. ☉		M. Anom. ☽		Ann. Arg.		☽'s Place computed				Diff. from Observat.		
	h	'	"	s	°	'	"	s	"	s	"	s	"	s	°	'	"		'	"
1689																				
Novem. 16.	11	59	0	2	6	12	43	4	29	6	1	0	0	2	6	14	40	+	1	57
Decem. 9.	6	1	0	11	28	43	54	5	21½	3	21	0	20½	11	28	48	40	+	0	14
10.	6	46	35	0	12	46	49	5	22½	4	4	0	21½	0	12	47	14	+	0	25
12.	8	26	33	1	12	13	8	5	24½	5	0½	0	23	1	12	10	35	—	2	29
13.	9	24	30	1	27	38	36	5	25½	5	14	0	24	1	27	36	10	—	2	20
1690																				
16.	12	42	0	3	15	14	54	6	28½	6	24	0	27	3	15	15	48	+	0	54
January 4.	3	3	46	11	11	12	59	6	17	2	24	1	14	11	11	13	8	+	0	9
6.	4	30	15	0	8	13	31	6	19	3	20½	1	16	0	8	14	36	+	1	5
10.	7	59	22	2	6	11	21	6	23	5	14½	1	19½	2	6	10	37	—	0	43
12.	10		49	3	7	5	21	6	25	6	12½	1	21	3	7	3	59	—	1	22
February 13.	11	14	0	3	22	36	28	6	26	6	25½	1	22	3	22	35	19	—	1	9
2.	2	25	39	3	16	57	24	7	15½	3	5	2	10	3	16	56	9	—	1	15
5.	4	51	10	1	16	31	33	7	18½	4	26	2	12½	1	16	34	15	+	1	42
7.	6	48	17	2	15	58	14	7	20½	5	24	2	14½	2	15	59	13	+	0	59
8.	7	51	54	3	0	56	20	7	21½	6	8	2	16½	2	0	56	31	+	0	11
10.	9	56	26	4	0	55	24	7	24	7	6	2	17	4	0	55	1	—	0	23
11.	10	52	31	4	15	42	10	7	25	7	20	2	18	4	15	41	49	—	0	27
14.	13	19	31	5	28	12	40	7	28	9	2	2	21	5	28	11	44	—	0	56
19.	17	3	55	8	2	23	20	8	3	11	12	2	25½	8	2	21	17	—	2	9
21.	18	45	37	8	27	1	25	8	5	0	10	2	27½	8	26	59	6	—	2	19

Year	Month	Date																										
1690	Febr. March	22.	19	37	40	9	9	26	9	8	6	0	24	2	28	9	9	23	26	+	1	54
		7.	5	50	38	2	26	22	8	18	6	6	12	3	9	2	26	25	20	+	2	30
		11.	9	43	23	4	24	31	8	22	8	8	8	3	13	4	24	33	15	+	1	30
		12.	10	33	9	5	8	31	8	23	22	8	22	3	14	5	8	33	15	+	1	17
		12.	11	18	30	5	22	16	8	24	37	9	5½	3	15	5	22	17	26	+	0	49
	April	14.	12	2	18	6	5	44	8	25½	19½	9	19½	3	15½	6	5	45	18	+	0	39
		25.	20	54	54	10	24	54	9	6½	21	2	21	25½	10	24	53	20	+	1	8
		7.	7	48	46	4	20	8	9	19	5	8	5	6	4	20	9	18	+	1	54
		8.	8	36	30	5	3	59	9	20	19	8	19	7	5	4	34	+	0	58
		9.	9	22	0	5	17	34	9	21	2	9	2	8	5	17	35	40	+	0	58
		10.	10	5	19	6	0	54	9	22	16	9	16	4	9	0	55	35	+	0	45
		11.	10	47	56	6	14	0	9	23	29	9	29	10	4	6	14	13	+	2	5
		12.	11	30	56	6	26	55	9	24	12½	10	12½	11	6	26	56	55	+	0	59
		13.	12	17	31	7	9	41	9	25	26	10	26	12	7	9	42	20	+	1	54
		14.	13	4	0	7	22	16	9	26	9½	11	9½	12½	7	22	17	34	+	0	34
		15.	13	52	44	8	4	45	9	27	23	11	23	13½	8	4	44	47	−	0	23
		18.	16	26	47	9	11	43	10	0	3½	2	3½	16	9	11	44	53	+	1	1
		20.	18	5	47	10	6	30	10	2	27	2	27	18	10	6	33	2	+	2	7
		22.	19	37	30	11	2	8	10	4	23½	27	3	20	11	2	8	45	+	3	39
		24.	21	16	38	11	29	14	33	10	6	23½	3	23½	21½	11	29	14	30	−	0	3
	May	14.	13	30	30	8	25	6	53	10	25½	7	0	7	8	8	25	8	48	+	1	55
		22.	19	41	40	0	6	50	26	11	3½	23	3	23	15	0	6	49	43	−	0	45
	June	3.	6	2	13	5	22	31	45	11	15	19	8	19	25	5	22	32	6	+	0	21
		1.	6	48	53	9	2	27	42	2	13½	15	11	15	12	9	2	31	20	+	3	38
	Septem.	8.	12	16	42	0	1	44	51	2	21	22	2	22	18	0	1	44	18	−	0	33
1691	February March Septem.	23.	3	55	10	1	19	39	56	8	6	16	3	16	18	1	19	40	45	+	0	49
		11.	18	27	51	9	7	30	5	8	22½	23½	10	23½	2	9	7	30	23	+	0	18
		22.	8	51	3	10	19	26	24	3	4	16	11	16	19	10	19	28	32	−	2	8

a, The Time of the Middle of this Eclipfe here fet down is from the Beginning and End ; but *Hevelius* fays he could not obferve the Beginning exactly. Several intermediate *Phafes* compared together fhew the Middle to have been about 4′ fooner ; to which the Moon's Place computed is 0ˢ. 6°. 14′. 3″. and Diff. + 34″.

b, b, b, The Moon's Places, obferved on *Feb.* 2. *April* 7. and *May* 22. are computed by myfelf, from the Obfervations; there being manifeftly Errors, either of the Computation or Prefs, in thofe printed in the *Hift. Cœleftis.*

Several obferved Latitudes of the Moon, which I have compared with the Tables, fhew them to be very near the Truth, both in the Motion of the Nodes, and alfo in the Quantity and Variation of the Inclination. I am,

<div style="text-align:center">

S I R,

Your humble Servant,

Richard Dunthorne.

</div>

XIV.